(12) UK Patent Application (19) GB (11) 2 126 910 A

(21) Application No 8319720
(22) Date of filing 21 Jun 1983
(30) Priority data
(31) 825426
(32) 28 Jul 1982
(33) South Africa (ZA)
(43) Application published
4 Apr 1984
(51) INT CL³
B01F 5/00 3/08
(52) Domestic classification
B1C 121 2012 425 524 AA
(56) Documents cited
GB 1580788
GB 1526322
(58) Field of search
B1C

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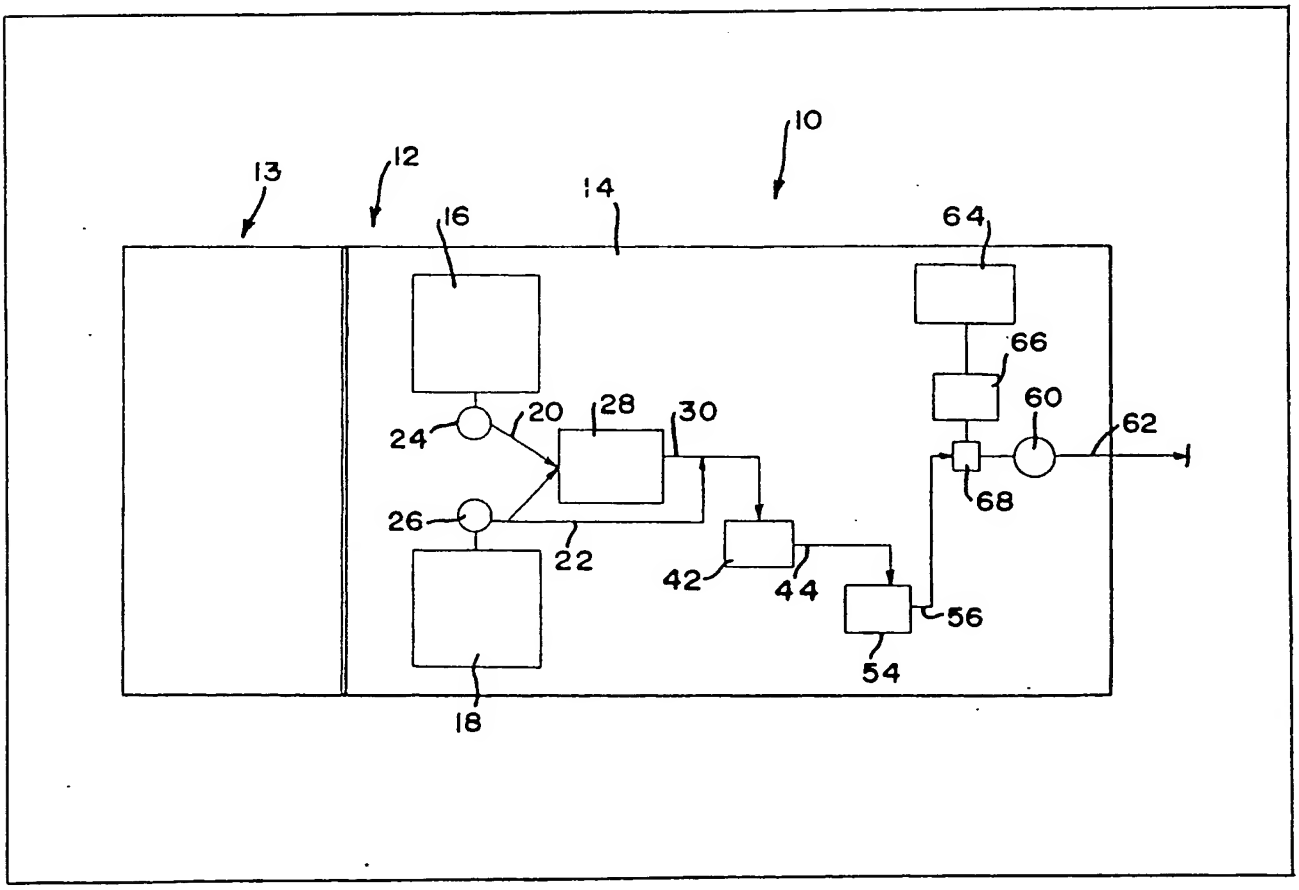
(54) Mobile mixing device for explosives

(57) Mixing apparatus is mounted on a vehicle 12 and a method for mixing the components of a liquid explosive by means of at least one static mixer 28. A plurality of static mixers connected in series may also be arranged. All the constituent materials are carried on the vehicle and the resultant mixture discharged to a point of use by a pump 60.



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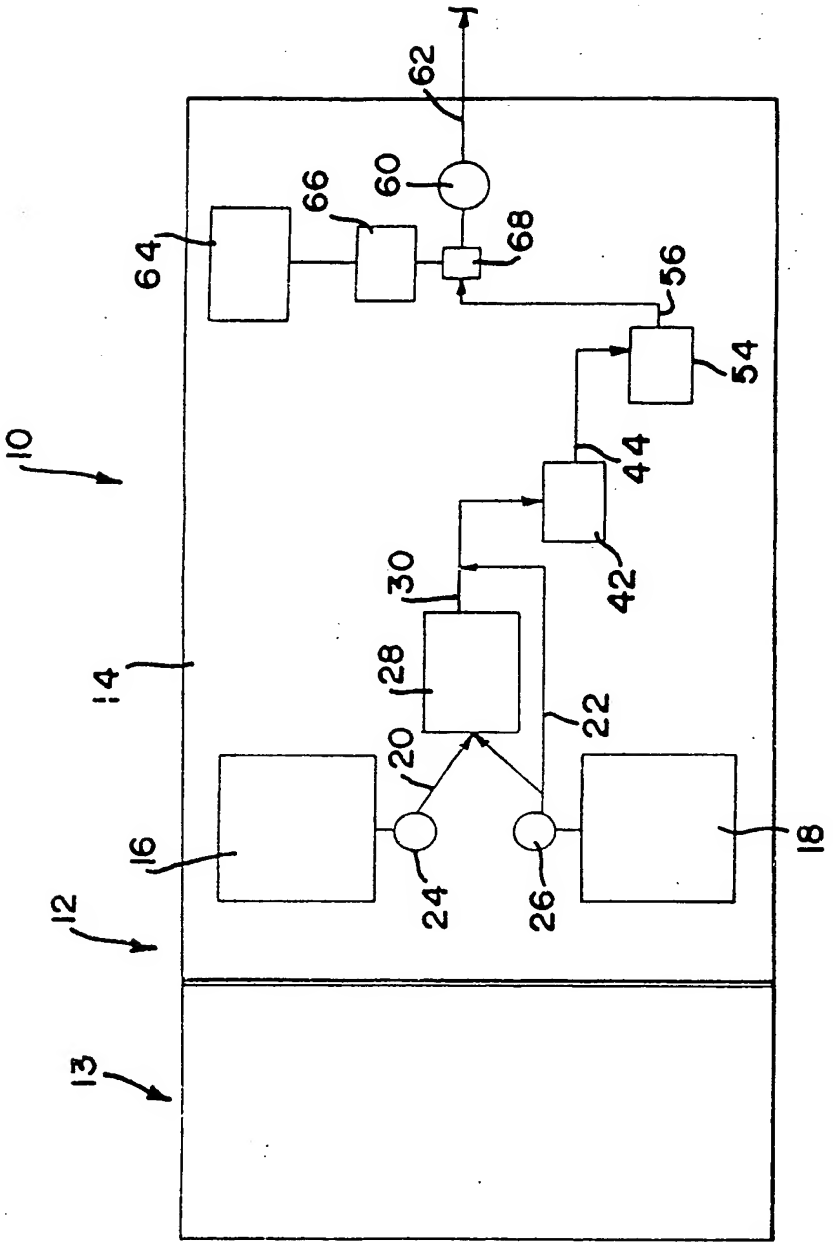

SPECIFICATION

Explosives mixing device

This invention relates to an explosives mixing device. In particular it relates to a mobile explosives mixing device suitable for on-site mixing of emulsion explosives.

According to the invention, broadly there is provided a mobile explosives mixing device which includes at least one static mixer, for mixing the components of a liquid explosive, mounted on a vehicle.

The or each static mixer may be suitable for mixing the oxidizer component and the fuel component of an emulsion explosive.

The vehicle may be in the form of a truck, and the device may include a placer pump on the truck for pumping explosive from the static mixer(s) down a hole, and storage tanks on the truck for the oxidizer component and the fuel component respectively, each tank being provided with a discharge pump for pumping the associated component at a desired flow rate and pressure to the static mixer(s).

There may be a single static mixer, or several static mixers arranged in series. Downstream of the static mixer(s), which will be connected to the tanks by appropriate flow lines, there will be a discharge flow line provided with said placer pump.

The discharge pumps for the oxidizer and fuel component tanks should preferably be capable of forcing the components under turbulent flow conditions and pressures of about 1000 PSI (7 MPa) or more through the static mixer(s), to form a suitable emulsion.

The device may include at least two static mixers, one or a number of which can be connected in line in series between the storage tanks and the placer pump, in different combinations, so as, within limits, to be able to vary the emulsion properties of the emulsion explosive, such as droplet size, rheology, or the like, as requirements in this regard can vary from site to site, and also with the nature of the explosive used.

The component tanks may be insulated and be provided with heating means, and means may be provided downstream of the static mixer(s) for doping and blending the explosive with a sensitizer such as microballoons, gas bubbles, atomised aluminium, or the like, the means being located on the truck. The means for doping and blending the explosive with the sensitizer may be a separate blender located upstream of the placer pump.

The invention will now be described, by way of example, with reference to the accompanying diagrammatic drawing, which shows, schematically, in plan view outline, an explosives mixing device in accordance with the invention.

In the drawing, reference numeral 10 generally designates an explosives mixing device in accordance with the invention. The device comprises a truck 12 having a cab 13 and load bed 14 on which is mounted an oxidizing component storage tank 18 and a fuel component storage tank 16. The tanks 16, 18 have discharge flow lines respectively designated 20 and 22, and respectively provided with discharge pumps 24 and 26. The flow line 20 feeds into the inlet of a first static mixer 28 mounted on the load bed 14 of the truck. The flow line 22 feeds into both the feed line 20 directly at the inlet of the first static mixer 28 and into a discharge flow line 30 leading from the first static mixer. Discharge flow line 30 leads to a further static mixer 42 mounted on the load bed 14. The static mixer 42 has a discharge flow line 44 which leads to a third static mixer 54 mounted on the load bed 14 and having a discharge flow line 56. The discharge flow line 56 discharges into a placer pump 60 having its own discharge flow line 62. A sensitizer storage hopper 64 is provided feeding via feed means 66 into the flow line 56 upstream of the pump 60. The feed means 66 feeds into the flow line 56 by means of a blender 68 for blending the sensitizer into the emulsion.

The tanks 16, 18 are provided with insulation and heating means (not shown).

It will be appreciated that, using appropriate fittings (not shown), such as valves, bypass flow lines, etc., the static mixer 28 alone can be placed in series between the tanks 16, 18 on the one hand, and the blender 68 on the other hand, or both the mixers 28, 42 can be placed in series between said tanks and blender, or indeed all three mixers 28, 42 and 54 can be placed in series between said tanks and blender, as desired.

It is contemplated that the static mixer 28 will be a coarse mixer, adapted to form a coarse emulsion. The mixers 42 and 54 will be progressively finer, so as to produce, when used, progressively finer emulsions. The pumps 24, 26 will have an output pressure of 1000 PSI (7 MPa) or more, and flows of from about 50 to about 80 kg/min (i.e. from about 0,8 to about 1,3 kg/s).

An example of a formulation which can be used by the device 10 is the following:

Component	Percentage by Mass
Ammonium nitrate (oxidising salt)	58,17
Sodium nitrate (oxidising salt)	14,00
Calcium nitrate	3,47
Water	11,99
P95 fuel oil (paraffinic hydrocarbon fuel available from BP Southern Africa (Proprietary) Limited)	2,00
Span 80 (sorbitan monooleate emulsifier available from Atlas Oil & Chemical Company (Proprietary) Limited)	0,70
Soya lecithin	0,70
B246 (emulsifier available from Imperial Chemical Industries PLC — Paints Division)	0,30
SASOLWAKS M1 Paraffin wax, available from SASOL Marketing Company Limited	1,34
C15/50 microballoons (available from 3M (South Africa) (Proprietary) Limited)	2,44
Atomised Aluminium available from HULETTS SA (Pty) Limited	4,89

It is contemplated that ammonium nitrate and water, heated tankers. Sodium and calcium nitrate and any other oxidizer about 85°C, will be transported to the site by insulated and heated tankers. Sodium and calcium nitrate and any other oxidiser ingredients will be mixed on-site with the ammonium nitrate and water, in heated, stirred, insulated storage tanks, to form an oxidiser component. A fuel component comprising all the remaining constituents except for the microballoons and atomised aluminium, can similarly be mixed on-site, heated and stirred in insulated storage tanks, to form a fuel component. These extra storage tanks (not shown) can conveniently be mounted on the truck adjacent the tanks 16 and 18, being used respectively to fill the tanks 16 and 18. In the tanks 16 and 18, the temperatures of the components will be maintained, and when blasting holes are to be charged, the pumps 24, 26 and 60 will be operated to mix the components and place the explosive. The feed means 66 will be used to feed the microballoons and atomized aluminium, as a mixture, from hopper 64 to the emulsion, upstream of the pump 60, which emulsion is at 60—70°C.

An advantage of the invention is its simplicity and versatility. The components required for the device are inexpensive, and substantially maintenance free. Safety is enhanced as the static mixers have no moving parts, and the device is versatile in that various combinations of static mixers can be used for controlling emulsion properties as described above. The device can therefore cater for many different applications, including the cartridging of explosives on-site.

The static mixers are convenient to mount on the truck, leading to a saving in space. All the components can thus be mounted in convenient and easily accessible positions on the truck load bed 14.

CLAIMS

1. A mobile explosives mixing device which includes at least one static mixer, for mixing the components of a liquid explosive, mounted on a vehicle.

2. A mixing device according to Claim 1, wherein the or each static mixer is suitable for mixing the oxidizer component and the fuel component of an emulsion explosive.

3. A mixing device according to Claim 2, wherein the vehicle is in the form of a truck and wherein the device includes a placer pump on the truck for pumping explosive from the static mixer(s) down a hole, and storage tanks on the truck for the oxidizer component and the fuel component respectively, each tank being provided with a discharge pump for pumping the associated component at a desired flow rate and pressure to the static mixer(s).

4. A mixing device according to Claim 3, which includes at least two static mixers, one or a number of which can be connected in-line in series between the storage tanks and the placer pump, in different combinations so as, within limits, to be able to vary the emulsion properties of the emulsion explosive.

5. A mixing device according to Claim 3 or Claim 4 wherein the component tanks are insulated and are provided with heating means, and wherein means are provided downstream of the static

mixer(s) for doping and blending the explosive with a sensitizer, the means being located on the truck.

6. A mixing device according to Claim 5, wherein the means for doping and blending the explosive with the sensitizer is a separate blender located upstream of the placer pump.

7. A mobile explosives mixing device according to Claim 1 substantially as described and illustrated herein.

8. A method of preparing a liquid explosive wherein the components of said explosive are mixed by means of at least one static mixer mounted on a vehicle.

9. A method according to Claim 8 wherein the said components comprise the oxidizer component and the fuel component of an emulsion explosive.

10. A method according to Claim 9 wherein the said components are pumped to the static mixer(s) by means of discharge pumps from storage tanks containing the separate components and mounted on the vehicle, each tank being provided with a discharge pump.

11. A method according to Claim 10 wherein the said components are pumped to the static mixer(s) under turbulent flow conditions and pressures of 1000 PSI or more.

12. A method according to any one of Claims 9 to 11 inclusive wherein the oxidiser component comprises an aqueous solution of oxidising salt comprising ammonium nitrate, sodium nitrate or calcium nitrate or a mixture of two or more of said nitrates, and the fuel component comprises fuel oil and emulsifier.

13. A method according to any one of Claims 8 to 12 inclusive wherein sensitiser is blended with the mixed explosive by blending means located on the vehicle.

14. A method of preparing a liquid explosive substantially as described herein with reference to the accompanying drawing.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1984. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.